APPENDIX I

GLOSSARY

ABSORPTION WAVEMETER—An instrument used to measure audio frequencies.

AMMETER—A meter used to measure current.

BACK RESISTANCE—The larger resistance value observed when you are checking the forward resistance of a semiconductor.

BAND PASS FILTER—A tuned circuit that passes only a specific frequency.

BAND REJECT FILTER—A tuned circuit that does not pass a specified band of frequencies.

BARRETTER—A type of bolometer characterized by an increase in resistance as the dissipated power rises.

BEAT FREQUENCY—The difference between the oscillator frequency and the unknown audio frequency.

BEL—The unit that expresses the logarithmic ratio between the input and output of any given component, circuit, or system.

BOLOMETER—A loading device that undergoes changes in resistance as changes in dissipated power occur.

CAVITY WAVEMETER—An instrument used to measure microwave frequencies.

CONTINUITY—An uninterrupted, complete path for current flow.

CORRECTIVE MAINTENANCE—Used to isolate equipment failures. Includes replacement of defective parts to return equipment to proper performance.

DAMPING—The process of smoothing oscillations of the meter pointer.

D'ARSONVAL METER MOVEMENT—The permanent-magnet moving coil movement used in most meters.

dBm—An abbreviation used to represent power levels above or below a 1-milliwatt reference.

DUMMY ANTENNA—See DUMMY LOAD.

DUMMY LOAD—A resistor used to replace the normal load, which is specifically designed to have low reactance and possess the ability to dissipate required amounts of power.

ELECTRODYNOMETER METER MOVEMENT—A meter movement using fixed field coils and a moving coil; usually used in wattmeters.

EXTERNALLY EXCITED METER—A term used to describe meters that get their power from the circuit to which they are connected.

FORWARD RESISTANCE—The smaller resistance value observed when you are checking the forward resistance of a semiconductor.

FREQUENCY METER—An instrument used to measure the rate at which ac voltages are generated.

GALVANOMETER—A meter used to measure small values of current by electromagnetic or electrodynamic means.

GENERAL PURPOSE ELECTRONIC TEST EQUIPMENT (GPETE)—Test equipment that has the capability, without modification, to generate, modify, or measure a range of electronic functions required to test two or more equipments or systems of basically different designs.

INDUCTANCE BRIDGE—An ac bridge circuit used to measure an unknown value of inductance.

MAINTENANCE—Work done to correct, reduce, or counteract wear, failure, and damage to equipment.

MEASURE (Metrology Automated System for Uniform Recall and Reporting)—A Navy standardized system designed to provide the recall, scheduling, and documenting of test equipment into calibration facilities.

MECHANICAL-ROTATION FREQUENCY—The speed in revolutions per minute of armatures in electric motors and engine-driven generators; blade speed in turbines.

MEGGER—A meter used to measure insulation resistance.

METER MOVEMENT—The part of the meter that moves to indicate some electrical value.

METER SHUNT—A resistor placed in parallel with the meter terminals; used to provide increased range capability.

OHMMETER—A meter used to measure resistance.

POWER FACTOR—An indication of the various losses of a capacitor, such as current leakage and dielectric absorption.

PREVENTIVE MAINTENANCE—Consists of mechanical, electrical, and electronic checks; used to determine whether or not equipment is operating properly.

SCAT CODES—A four-digit subcategory code used to identify the functional measurement parameters that can be satisfied by any one of many pieces of test equipment.

SELF-EXCITED METER—A term used to describe meters that operate from their own power sources.

SENSITIVITY—(1) For an ammeter, the amount of current that will cause full-scale deflection of the meter. (2) For a voltmeter, the ratio of the voltmeter resistance divided by the full-scale reading of the meter; expressed in ohms per volt.

SCLSIS (Ship Configuration and Logistics Support Information System)—This encompasses the automated data processing system and all practices and procedures used for identification and status accounting of ship's configuration, logistics, technical data reviews, and equipment configuration audits.

SHORT CIRCUIT—An unintentional current path between two components in a circuit or between a component and ground; usually caused by a circuit malfunction.

SPECIAL PURPOSE ELECTRONIC TEST EQUIPMENT (SPETE)—Test equipment that is specifically designed to generate, modify, or measure a range of electronic functions of a specific or peculiar nature on a single system or equipment.

STROBOSCOPE—An instrument that allows viewing of rotating or reciprocating objects by producing the optical effect of a slowing down or stopping motion.

SYMPTOM ELABORATION—Using built-in indicating instruments or other aids to define an equipment malfunction.

SYMPTOM RECOGNITION—Recognition of a situation in equipment operation that is not normal.

TACHOMETER—An instrument that measures the rate at which a shaft is turning.

TEST EQUIPMENT INDEX—The Navy guide used to assist in identifying portable electrical/electronic test equipment required for support of prime electrical/electronic, IC, weapons, and reactor instrumentation systems.

TEST POINTS—Locations in equipment that are accessible to the technician's probes where operating voltages or signals can be monitored.

THERMISTOR—A type of bolometer characterized by a decrease in resistance as the dissipated power increases.

TROUBLESHOOTING—A procedure used to evaluate equipment performance and repair equipment when it fails to operate properly.

TUNED CIRCUIT—A circuit that is used as a filter which passes or rejects specific frequencies.

VOLTMETER—A meter that is used to measure voltage.

WATT—The unit of electrical power that is the product of voltage and current.

WATTMETER—An electrodynamometer type meter used to measure electrical power.

WAVEFORM ANALYSIS—Observation of displays of voltage and current variations with respect to time or by harmonic analysis of complex signals.

WAVEMETER—Calibrated resonant circuits that are used to measure frequency.

WHEATSTONE BRIDGE—An ac bridge circuit used to measure unknown values of resistance, inductance, or capacitance.

APPENDIX II

REFERENCES USED TO DEVELOP THIS TRAMAN

NOTE: Although the following references were current when this TRAMAN was published, their continued currency cannot be assured. Therefore, you need to ensure that you are studying the latest revision.

CHAPTER 1

EIMB, *Test Equipment*, NAVSEA 0967-LP-000-0040, Naval Sea Systems Command, Washington, DC, 1981.

EIMB, *Test Methods and Practices*, NAVSEA 0967-LP-000-0130, Naval Sea Systems Command, Washington, DC, 1980.

Electronic Test Equipment Calibration Program Indoctrination Handbook, NAVMAT P-9491, Naval Material Command, Washington, DC, 1979.

Metrology Automated System for Uniform Recall and Reporting (MEASURE) Users Manual, OP 43P6A, Chief of Naval Operations, Washington, DC, 1984.

Navy Electricity and Electronics Training Series, Module 3, *Introduction to Circuit Protection, Control, and Measurement*, NAVEDTRA B72-03-00-93, Naval Education and Training Professional Development and Technology Center, Pensacola, FL, 1993.

Portable Electrical/Electronic Test Equipment (PEETE) Index NAVSEA ST-AA-IDX-010-PEETE, Naval Sea Systems Command, Washington, DC, 1986.

Ships Configuration and Logistics Support Information System (*SCLSIS*), S0752-AA-SPN-010/SCLSIS, Naval Sea Systems Command, Washington, DC, 1988.

Standard General Purpose Electronic Test Equipment, MIL-STD 1364(Series) (NAVY), Naval Sea Systems Command, Washington, DC, 1991.

Stowage Guide for Portable Electrical/Electronic Test Equipment (PEETE) NAVSEA ST000-AB-GYD-010/PEETE, Naval Sea Systems Command, Washington, DC, 1987.

CHAPTER 2

Electronics Technician 3 and 2, NAVEDTRA 80197-1, Naval Education and Training Professional Development and Technology Center, Pensacola, FL, 1987.

Fire Controlman Third Class, NAVEDTRA 10276-1, Naval Education and Training Professional Development and Technology Center, Pensacola, FL, 1988.

Navy Electricity and Electronics Training Series, Module 9, *Introduction to Wave-Generation and Wave-Shaping Circuits*, NAVEDTRA 172-09-00-83, Naval Education and Training Professional Development and Technology Center, Pensacola, FL, 1983.*

Navy Electricity and Electronics Training Series, Module 7, *Introduction to Solid-State Devices and Power Supplies*, NAVEDTRA B72-07-00-92, Naval Education and Training Professional Development and Technology Center, Pensacola, FL, 1992.

Navy Electricity and Electronics Training Series, Module 21, *Test Methods and Practices*, NAVEDTRA B72-21-00-87, Naval Education and Training Professional Development and Technology Center, Pensacola, FL, 1987.

Navy Electricity and Electronics Training Series, Module 2, *Introduction to Alternating Current and Transformers*, NAVEDTRA 172-02-00-91, Naval Education and Training Professional Development and Technology Center, Pensacola, FL, 1991.

Radioman 3 & 2, NAVEDTRA 10228-H1, Naval Education and Training Professional Development and Technology Center, Pensacola, FL, 1991.

CHAPTER 3

Navy Electricity and Electronics Training Series, Module 5, *Introduction to Generators and Motors*, NAVEDTRA B72-05-00-94, Naval Education and Training Professional Development and Technology Center, Pensacola, FL, 1994.

Navy Electricity and Electronics Training Series, Module 1, *Introduction to Matter, Energy, and Direct Current*, NAVEDTRA B72-01-00-92, Naval Education and Training Professional Development and Technology Center, Pensacola, FL, 1992.

Navy Electricity and Electronics Training Series, Module 3, *Introduction to Circuit Protection, Control, and Measurement*, NAVEDTRA B72-03-00-93, Naval Education and Training Professional Development and Technology Center, Pensacola, FL, 1993.

CHAPTER 4

8000A Digital Multimeter, NAVSEA 0969-LP-279-9010, Naval Sea Systems Command, Washington, DC.

Navy Electricity and Electronics Training Series, Module 7, *Introduction to Solid-State Devices and Power Supplies*, NAVEDTRA B72-07-00-92, Naval Education and Training Professional Development and Technology Center, Pensacola, FL, 1992.

Navy Electricity and Electronics Training Series, Module 13, *Introduction to Number Systems and Logic Circuits*, NAVEDTRA B72-13-00-86, Naval Education and Training Professional Development and Technology Center, Pensacola, FL, 1986.*

Operation and Maintenance Instructions, Volt-Ohm-Milliammeter 260 Series, NAVSEA 0969-LP-286-1010, Naval Sea Systems Command, Washington, DC, 1977.

CHAPTER 5

EIMB, *Test Methods and Practices*, NAVSEA 0967-LP-000-0130, Naval Sea Systems Command, Washington, DC, 1980.

Huntron Tracker 2000 Operation and Maintenance Manual, Mill Creek, WA, 1985.

Navy Electricity and Electronics Training Series, Module 10, *Introduction to Wave Propagation, Transmission Lines, and Antennas*, NAVEDTRA 172-10-00-83, Naval Education and Training Professional Development and Technology Center, Pensacola, FL, 1983.*

Navy Electricity and Electronics Training Series, Module 12, *Modulation Principles*, NAVEDTRA 172-12-00-83, Naval Education and Training Professional Development and Technology Center, Pensacola, FL, 1983.*

CHAPTER 6

EIMB, *Test Methods and Practices*, NAVSEA 0967-LP-000-0130, Naval Sea Systems Command, Washington, DC, 1980.

EW Technician AN/SLQ-32A(V)3 ECM Maintenance Trainee Guide, A-102-0216 (Vol 1), Chief of Naval Technical Training, Pensacola, FL, 1992.

Navy Electricity and Electronics Training Series, Module 9, *Introduction to Wave-Generation and Wave-Shaping Circuits*, NAVEDTRA 172-09-00-83, Naval Education and Training Professional Development and Technology Center, Pensacola, FL, 1983.*

Navy Electricity and Electronics Training Series, Module 6, *Introduction to Electronic Emission, Tubes, and Power Supplies*, NAVEDTRA B72-06-00-92, Naval Education and Training Professional Development and Technology Center, Pensacola, FL, 1992.

Tektronix 492/492P Spectrum Analyzer Instruction Manual, Beaverton, OR, 1981.

*Effective 1 September 1986, the Naval Education and Training Program Development Center became the Naval Education and Training Program Management Support Activity. Effective 1 October 1996, the name was changed to Naval Education and Training Professional Development and Technology Center.

MODULE 16 INDEX

A

Absorption wavemeter, 2-15
Ac bridges, use of, 1-23
Ac/dc differential voltmeter, 4-16
Ammeter connections, 3-10
Ammeter sensitivity, 3-11
Amplitude of a signal, components used to determine, 6-16
Astigmatism control and focus control, 6-14
Attenuator control, 6-18
Audio and video signal generators, 5-8
Audio frequencies, 2-14
Audio range, frequencies above, 2-15

B

Basic meters, 3-1
Beam-deflection plate action, 6-7
  ammeter connections, 3-10
  ammeter sensitivity, 3-11
  basic meter movement, 3-2
  continuity tests, 3-27
  D'Arsonval meter movement, 3-3
  dc ammeter, 3-6
  dc voltmeter, 3-12
  electrodynamometer-type meters, 3-22
  extending voltmeter ranges, 3-14
  galvanometer, 3-2
  influence of a voltmeter in a circuit, 3-16
  megohmmeter, 3-21
  meters, 3-1
  meters used for measuring resistance, 3-17
  ohmmeter, 3-17
  resistance test, 3-29
  shunts, 3-6
  techniques for meter use, 3-27
  test for grounds, 3-28
  test for shorts, 3-28
  voltage tests, 3-29
  voltmeter circuit connections, 3-15
  voltmeter sensitivity, 3-16
  wattmeter, 3-25
Beam finder, 6-15
Beta measurements, 4-21
Bolometer, 2-5
Bridges, capacitance, inductance, and resistance, 1-21, 4-22

C

Calibrated label, 1-3
Calibrated—refer to report label, 1-4
Calibration and repair procedures, 1-7
Calibration not required label, 1-6
Calibration status, 1-3
Calibration void if seal broken label, 1-6
Capacitance measurements, 1-21
Cathode-ray tubes (CRT) 6-1
Cavity wavemeter, 2-16
Common test equipment, 4-1
  ac/dc differential voltmeter, 4-16
  ac voltage measurements, 4-8
  accessories, 4-14
  basic digital multimeter measurements, 4-12
  beta measurements, 4-21
  block diagram analysis, 4-13
  capacitance measurements, 4-24
  conventional transistorized voltmeter (TVM) mode, 4-18
  current measurements, 4-10
  dc voltage measurements, 4-6
  differential null mode, 4-19
  diode measurements, 4-21
  electrode resistance measurements, 4-21
  electronic digital multimeters, 4-11
  front panel controls, 4-17
  functional block diagram, 4-19
  ICO measurements, 4-21
  inductance measurements, 4-24
  internal battery models, 4-12
  measuring resistance, voltage, and current with a nonelectronic VOM, 4-1
  meter design characteristics, 4-15
  modes of operation, 4-16
  multimeters, 4-1
  operating features, 4-12

Common test equipment—Continued
output voltage measurements, 4-9
overload protection, 4-12
resistance-capacitance-inductance (RCL) bridges, 4-22
resistance measurements, 4-2, 4-23
transistor tester, 4-19
Continuity tests, 3-27
Conventional transistorized voltmeter (TVM) mode, 4-18
Coupling, 6-24
CRT designations, 6-10
CRT display quality, components used to adjust, 6-13
CRT graticule, 6-10
Current measurement, 1-19, 4-10

D

D'Arsonval meter movement, 3-3
Dc ammeter, 3-6
Dc voltage measurement, 4-6
Dc voltmeter, 3-12
De-energized circuits, working on, 1-16
Decibel system, 2-2
Deflection, factors influencing, 6-4
Differential null mode, 4-19
Diode measurements, 4-21
Diodes, testing, 2-20
testing diodes with an ohmmeter, 2-20
testing with oscilloscope, 2-20
Direct-measuring power meter, 5-2
Dual-trace capability, 6-30

E

Electrodynamometer-type meters, 3-22
Electron-beam deflection system, 6-3
Electron gun, 6-2
Electronic digital multimeter, 4-11
Electronic frequency counter, 5-11
Electronic test equipment classification, 1-2
Electrostatic lenses and focusing, 6-2
Energized circuits, working on, 1-14

F

Focus control and astigmatism control, 6-14
Frequency counters, 5-11

G

Galvanometer, 3-2
Grounding of power tools and equipment, 1-17
Grounds, test for, 3-28

H

Heterodyne frequency meters, 2-13
Horizontal and vertical plates, 6-5
Horizontal and vertical position controls, 6-15
Horizontal deflection mode, components used, 6-25

I

ICO measurements, 4-21
Inactive—calibrate before use label, 1-6
Indirect—measuring power meters, 5-4
Inductance measurements, 1-21, 4-24
Integrated circuit (IC) testing device, 5-20
Intensity control, 6-14
Internal battery models, 4-12

J

Joint Electronics Type Designation System (JETDS), 1-2

M

Mechanical-rotation frequency measurement, 2-8
Megohmmeter, 3-21
Meter movement, basic, 3-2
Meter use, techniques for, 3-27
Meters, 3-1
Metrology Automated System for Uniform Recall and Reporting (MEASURE), 1-8
Miscellaneous measurements, 2-1
absorption wavemeter, 2-15
audio frequencies, 2-13
bolometer, 2-5

Miscellaneous measurements—Continued
cavity wavemeter, 2-16
decibel system, 2-2
electrical output frequency, 2-12
electronic frequency counters, 2-16
frequencies above the audio range, 2-15
frequency measurements, 2-7
heterodyne frequency meters, 2-13
measurement methods, 2-4
mechanical-rotation frequency measurement, 2-8
power measurements, 2-1
power supply checks, 2-22
resistance checks, 2-23
stroboscope, 2-10
tachometer, 2-8
testing diodes, 2-20
testing diodes with an ohmmeter, 2-20
testing semiconductor devices, 2-19
testing transistors, 2-22
testing with oscilloscopes, 2-20
thermistor bridge, 2-6
transistor checks, 2-23
tuned circuits, 2-13
use of the oscilloscope, 2-17, 6-27
use of the spectrum analyzer, 2-18
visual inspection, 2-23
voltage checks, 2-23
waveform analysis, 2-17
Multimeters, 4-1

O

Ohmmeter, 3-17
Oscilloscope control components, 6-10
Oscilloscope, the, 6-1
accessories, 6-35
attenuator control, 6-18
beam deflection plate action, 6-7
beam finder, 6-15
cathode and control grid, 6-2
cathode-ray tubes, 6-1
components used to adjust CRT display quality, 6-13
components used to calibrate the probe of the scope, 6-26
Oscilloscope—Continued
components used to determine amplitude of a signal, 6-16
components used to determine period time of the display, 6-20
components used to display the waveform, 6-12
components used to provide a stable display, 6-22
components used to select horizontal deflection mode, 6-25
components used to select scope triggering, 6-25
components used to select vertical deflection operating mode, 6-30
components used to select vertical operating mode, 6-19
coupling, 6-24
CRT designations, 6-10
CRT graticule, 6-10
dual-trace capability, 6-30
electron beam deflection system, 6-3
electron gun, 6-2
electrostatic lenses and focusing, 6-2
factors influencing deflection, 6-4
focus control and astigmatism control, 6-14
horizontal and vertical position controls, 6-15
input connector, 6-17
intensity control, 6-14
number of cycles on the screen, 6-28
obtaining a pattern on the screen, 6-28
oscilloscope control components, 6-10
other dual-trace oscilloscope controls, 6-34
similarities among oscilloscopes, 6-27
source, 6-23
trace rotation control, 6-15
trigger level/slope, 6-23
turning on the scope, 6-28
using the oscilloscope, 6-27
vertical and horizontal plates, 6-6
vertical position control, 6-17
Output voltage measurement, 4-9

P

Period time of the display, components used to determine, 6-20
Power measurements, 2-1
Power meters, 5-1
Probe of the scope, components used to calibrate the, 6-26

R

Radio-frequency (rf) signal generators, 5-10
Rejected—refer to attached tag label, 1-6
Repair procedures, 1-7
Resistance-capacitance-inductance (RCL) bridges, 1-21, 4-20
Resistance measurements, 1-20, 4-21
Resistance, meters used for measuring, 3-17
Resistance test, 3-29

S

Safety shorting probe, 1-16
Scope triggering, components used to select, 6-25
Ship Configuration and Logistic Information System (SCLSIS), 1-3
Shorts, test for, 3-28
Shunts, 3-6
Signal Generators, 5-8
Special-application test equipment, 5-1
  audio and video signal generators, 5-8
  direct-measuring power meter, 5-2
  frequency counters, 5-11
  general description of the frequency counters, 5-12
  indirect-measuring power meters, 5-4
  integrated circuit (IC) testing device, 5-20
  interpreting power measurements made by a wattmeter, 5-3
  operation of the wattmeter, 5-3
  power meters, 5-1
  radio-frequency (rf) signal generators, 5-10
  signal generators, 5-8
  tracker 2000, 5-22
Special calibration label, 1-5
Spectrum analyzer, 6-37
Spectrum analyzer—Continued
  basic functional description, 6-38
  converter section, 6-38
  digital control section, 6-40
  display section, 6-39
  frequency control section, 6-39
  front panel controls, indicators, and connectors, 6-40
  IF section, 6-39
  normal indications upon power on, 6-44
  power and cooling section, 6-40
  use of the, 2-18
Stable display, components used to provide a, 6-22
Stroboscope, 2-10

T

Tachometer, 2-8
Test equipment administration, 1-1
  "no reject" policy, 1-7
  calibrated—refer to report label, 1-4
  calibration and repair, 1-3
  calibration label, 1-3
  calibration not required label, 1-6
  calibration status, 1-3
  calibration void if seal broken label, 1-6
  electronic test equipment classification, 1-2
  inactive—calibrate before use label, 1-6
  Joint Electronics Type Designation System (JETDS), 1-2
  Metrology Automated System for Uniform Recall and Reporting (MEASURE), 1-8
  rejected—refer to attached tag label, 1-6
  repair procedures, 1-7
  responsibility for repair and maintenance of test equipment, 1-7
  special calibration label, 1-5
  stowage and handling of test equipment, 1-7
  test equipment identification, 1-2
  user calibration label, 1-5
Test equipment, using, 1-12
  basic measurements, 1-18
  capacitance, inductance, and resistance bridges, 1-21

Test equipment, using—Continued
capacitance measurements, 1-21
general test equipment information, 1-12
grounding of power tools and equipment, 1-17
inductance measurements, 1-21, 4-24
instrument precautions, 1-12
other instrument precautions, 1-13
resistance measurements, 1-20, 4-23
safety precautions, 1-12
safety shorting probe, 1-16
use of ac bridges, 1-23
voltage and current, 1-19
Wheatstone bridge, 1-21
working on de-energized circuits, 1-16
working on energized circuits, 1-14
Thermistor bridge, 2-6
Trace rotation control, 6-15
Transistor tester, 4-19
Transistors, testing, 2-22
power supply checks, 2-22
resistance checks, 2-23
transistor checks, 2-23, 4-20
visual inspection, 2-23
voltage checks, 2-23
Trigger level/slope, 6-23

U

User calibration label, 1-5

V

Vertical and horizontal plates, 6-6
Vertical operating mode, components used to select, 6-19
Voltage tests, 3-29
Voltmeter circuit connections, 3-15
Voltmeter ranges, extending, 3-14
Voltmeter sensitivity, 3-16

W

Wattmeter, 3-25
Wattmeter, operation of the, 5-3
Waveform analysis, 2-17
Waveform, components used to display the, 6-12
Wheatstone bridge, 1-21